

What Is Claimed Is:

1. A starting device (1) for an internal combustion engine,

-having a switching control device (7) for controlling a starter motor (2), comprising:

--at least one power switching module (4, 5) which connects the starter motor (2) to a voltage source (6), and which is activated via at least one control line (16, 18) assigned to the at least one power switching module (4, 5) and/or at least one control stage 10, 11) assigned to the at least one power switching module (4, 5);

--a control electronics (15) for controlling the at least one power switching module (4, 5);

wherein

-the switching control device (7) further has:

-a release device (29 - 36) recording the power flow of the internal combustion engine, which is designed in such a way that, when there is no frictional connection between the internal combustion engine and a power train assigned to it, it makes available on a release signal channel (29, 31, 34) a release signal for releasing the activating switching procedure by the at least one control line (16, 18), including:

--a first release switching channel (22) working independently of the control electronics (15),

--a second release switching channel (26) working together with the control electronics (15),
--the release switching channels (22, 26) being set up in such a way that an initiation of the activating switching procedure takes place only during simultaneous release switching setting of the release switching channels (22, 26);

-a diagnosis device (40 - 45) which is designed in such a way that, at the ending of making available the release signal for the activating switching procedure by the release device (29, 36), it records a switching setting representing the release switching setting of the first release switching channel (22).

2. The starting device as recited in Claim 1, wherein the first release switching channel (22) is designed as a hardware release switching channel.
3. The method as recited in Claim 1 or 2, wherein the second release switching channel (26) is designed as a software release switching channel, it being particularly controlled via a microcomputer of the control electronics (15).
4. The starting device as recited in one of the preceding claims, wherein the diagnosis device (40 - 45), which in particular may be a part of the control electronics (15), includes at least one A/D transformer for recording the release switching setting, particularly for recording the control of the power modules (4, 5).
5. The starting device as recited in one of the preceding claims,

wherein at least two power switching modules (4, 5) connected in series are provided, the diagnosis device (40 - 45) collaborating with the control electronics (15), and being designed in such a way that, at the ending of making available the release signal (29) for the activating switching procedure, it does not deactivate at least one power switching module (4, 5) via the control electronics (15), and for the diagnosis of first release switching channel (22) it records the switching state of the control line (16, 18) and/or the control stages (10, 11) of the not-deactivated power switching module (4, 5), in particular via the diagnosis lines (41, 44) of the diagnosis device (40 - 45), the diagnosis device (40 - 45) in particular being designed in such a way that it monitors the switching off of an output of control stages (10, 11) upon the ending of making available the release signals (29).

6. The starting device as recited in Claim 5, wherein the diagnosis device (40 - 45) is designed in such a way that, in response to sequential starter motor controls for the internal combustion engine, at the ending of making available the release signal for the activating switching procedure, in comparison to the preceding starting procedure, in each case it does not deactivate at least one other power switching module (4, 5).
7. The starting device as recited in Claim 6, wherein the diagnosis device (40 - 45) has a selecting device by which a controlled non-deactivation of power switching modules takes place in response to sequential starting motor activations according to a predefined non-deactivating sequence.

8. The starting device as recited in one of the preceding claims,
wherein the diagnosis device (40 - 45) is designed in such a way that, when recording an active switching state on one of the control lines (16, 18), after the ending of making available the release signal via the control electronics (15), it initiates a deactivation of all power switching modules (4, 5).
9. The starting device as recited in one of the preceding claims,
wherein the diagnosis device (40 - 45) is designed in such a way that, when recording an active switching state on one of the control lines (16, 18), after the ending of making available the release signal via the control electronics (15), it activates a warning signal transmitter (55), in particular a warning light.
10. The starting device as recited in one of the preceding claims,
wherein the diagnosis device (40 - 45) is designed in such a way that, when recording an active switching state on one of the control lines (16, 18), after the ending of making available the release signal via the control electronics (15), it induces an entry to be made of a data sequence assigned to the error in a storage medium (56) that can be read out and preferably collaborates with the control electronics (15).
11. The starting device as recited in one of the preceding claims,
characterized by a rotational speed sensor (52) collaborating with the release device (29 - 36) for recording the running of the internal combustion engine.

12. The starting device as recited in one of the preceding claims,
wherein the release device (29 - 36) has: the release signal channel (29), which is designed in such a way that, as a function of a first operating parameter of the internal combustion engine, particularly an operating parameter representing the running of the internal combustion engine and/or an operating parameter representing the frictional connection of the transmission to the internal combustion engine, it makes available a release signal for the release of the activating switching procedure and an additional release signal (31, 34), which is designed in such a way that, as a function of a second operating parameter of the internal combustion engine, in particular an operating parameter representing the running of the internal combustion engine and/or an operating parameter representing the frictional connection of the transmission to the internal combustion engine, it makes available an independent release signal which is recorded by the control electronics (15).

13. The starting device as recited in Claim 12,
wherein the release device (29 - 36) has at least one frictional connection sensor (30, 33, 36) recording the frictional connection between an engine and a transmission or a power train of the internal combustion engine, for the recording of one of the two operating parameters.

14. A method for starting an internal combustion engine using a starter motor (2),

-in which a switching control device (7) controls the starter motor (2), in that

--at least one power switching module (4, 5) connects the starter motor (2) to a voltage source (6), and the power switching module (4, 5) is activated via at least one control line (16, 18) assigned to the at least one power switching module (4, 5) and/or via at least one control stage (10, 11) assigned to the at least one power switching module (4, 5);

--a control electronics (15) controls the at least one power switching module (4, 5);

wherein

-a release device (29 - 36) of the switching control device (7) recording the power flow of the internal combustion engine, at the time when there is no frictional connection between the internal combustion engine and a power train assigned to it, makes available a release signal for releasing the activating switching procedure via the at least one control line (16, 18),

--a first release switching channel (22) of the release device (29 - 36), working independently of the control electronics (15), switching as a function of the release signal, and

--a second release switching channel (26) of the release device (29 - 36), collaborating with the control electronics (15), switching as a function of the release signal, and

--the release switching channels (22, 26) initiating the activating switching procedure only when there is a simultaneous release switching setting of the first and the second release channel (22, 26);

-a diagnosis device (40 - 45) of the switching control device (7), at the ending of making available the release signal for the activating switching procedure by the release device (29 - 36), records a switching setting representing the release switching setting of the first release switching channel (22).

15. The method as recited in Claim 14, wherein the diagnosis device (40 - 45) records the release switching setting via at least one A/D transformer (42, 45).
16. The method as recited in Claim 14 or 15, wherein at least two power switching modules (4, 5) connected in series are used, the diagnosis device (40 - 45) collaborating with the control electronics (15), and at the ending of making available the release signal (29) for the activating switching procedure, it does not deactivate at least one power switching module (4, 5) via the control electronics (15), and for the diagnosis of first release switching channel (22) it records the switching state of the control line (16, 18) and/or the control stages (10, 11) of the not-deactivated power switching module (4, 5), in particular via the diagnosis lines (41, 44) of the diagnosis device (40 - 45); the diagnosis device (40 - 45) in particular being designed in such a way that it monitors the switching off of an output of control stages (10, 11) upon the ending of making available the release signal (29).
17. The method as recited in Claim 16, wherein the diagnosis device (40 - 45), in response to sequential starter motor activations for the internal combustion engine, at the ending of making available

the release signal for the activating switching procedure, in comparison to the preceding starting program, in each case does not deactivate at least one other power switching module (4, 5).

18. The method as recited in Claim 17, wherein a selection device of the diagnosis device (40 - 45) undertakes a controlled non-deactivation of the power switching modules (4, 5) in response to sequential starting motor activations according to a predefined non-deactivating sequence.
19. The method as recited in one of Claims 14 through 18, wherein the diagnosis device (40 - 45) initiates a deactivating of all power switching modules (4, 5) in response to the recording of an active switching state after the ending of making available the release signal via the control electronics.
20. The method as recited in one of Claims 14 through 19, wherein the diagnosis device (40 - 45), in response to a recording of an active switching state after the ending of making available the release signal via the control electronics (15), activates a warning signal transmitter (55), in particular, a warning light.
21. The method as recited in one of Claims 14 through 20, wherein the diagnosis device (40 - 45), upon recording an active switching state after the ending of making available the release signal via the control electronics (15), stores a data sequence assigned to the error in a storage medium (56) that preferably

collaborates with the control electronics (15) and is able to be read out.

22. The method as recited in one of Claims 14 through 21,

wherein the release device (29 - 36) for recording the running of the internal combustion engine collaborates with a rotational speed sensor (52).

23. The method as recited in one of Claims 14 through 22,

wherein the release device (29 - 36) includes the release signal channel (29), which as a function of a first operating parameter of the internal combustion engine, particularly an operating parameter representing the running of the internal combustion engine and/or of an operating parameter representing the frictional connection of the transmission to the internal combustion engine, makes available a release signal for the release of the activating switching procedure, and includes an additional release signal channel (31, 34), which, as a function of a second operating parameter of the internal combustion engine, in particular an operating parameter representing the running of the internal combustion engine and/or an operating parameter representing the frictional connection of the transmission to the internal combustion engine, makes available an independent second release signal, which is recorded by the control electronics (15).

24. The method as recited in Claim 23, wherein the release device (29 - 36) records as one of the two operating parameters the frictional connection between an engine and a transmission or power train of

the internal combustion engine.

25. A starting device (1) for an internal combustion engine,

-having a switching control device (7) for controlling a starter motor (2), comprising:

--a control device for a starter motor via at least one power module (4, 5) having an assigned control stage (10) and the control logic (8, 9) as well as a release device (30), which is designed in such a way that it detects the non-present frictional connection of the internal combustion engine to the transmission and releases via a release switching channel (26) the control of the starter motor (2) via control electronics (15), and redundantly releases the control of the starter motor (2) via an additional release switching channel (22) that is independent of the control electronics (15),

wherein

-a diagnosis device (40 - 45) is provided which is designed in such a way that

-the function of the release switching channel (22) that is independent of control electronics (15) tested in such a way that, upon the departure of the release signal (29) of the release device (30), the control of a power module is still maintained by the control electronics (15) and the ability to be switched off of the power module (4, 5) is checked in the entire chain of effectiveness via the release switching channel (22) that is independent of the control electronics (15).

26. A method for starting an internal combustion engine using a starter motor (2),

-in which a switching control device (7) controls the starter motor (2), the control of the starter motor (2) taking place via at least one power module (4, 5) having an assigned control stage (10, 11) and the control logic (8, 9),

-in which a release device (30)

--detects the non-present frictional connection of the internal combustion engine to the transmission and

--releases, via a release switching channel (26), the control of the starter motor (2) via a control electronics (15) and

--releases redundantly the control of the starter motor (2) via an additional release switching channel (22) that is independent of the control electronics (15),

wherein

-the function of the release switching channel (22) that is independent of the control electronics (15) is checked in that

--upon the departure of the release signal (29) of the release device (30) the control of a power module (4, 5) is still maintained by the control electronics (15) and

--the ability to be switched off of the power module (4, 5) in the entire chain of effectiveness is checked

via the release switching channel (22) that is independent of the control electronics (15).